CLAIMS

What is claimed is:

1. A method for charging an electrical storage device so as to extend the life thereof, comprising:

developing an essentialized cell model structure of the electrical storage device;

determining model parameters for charge-discharge data of said structure; and

determining charge-discharge behavior of said structure in a voltage-charge plane.

2. The method according to claim 1, further comprising:

measuring voltage values of said structure based upon said charge-discharge behavior; and

deriving an instantaneous damage rate from said measured voltage values.

3. The method according to claim 2, further comprising:

developing a charging profile based upon said instantaneous damage rate, wherein said charging profile optimizes a charging current with respect to the damage per cycle so as to extend the overall life of the electrical storage device.

4. An optimal re-charging controller for an electrical storage device, comprising:

a simulation processor receiving an input signal sent to the electrical storage device and a measured output signal generated by the electrical storage device, wherein said simulation processor models a plurality of states of the electrical storage device and generates an estimated output signal so that the controller mitigates damage to the electrical storage device.

5. The controller according to claim 4, wherein said processor comprises:

a feedback component which receives said measured output signal and said estimated output signal to generate a correction signal; and

an observer component which receives said correction signal and said input signal to generate said estimated output signal and an estimated internal state signal, wherein said estimated output signal converges a plurality of modeled dynamic states to corresponding states of the electrical storage device.

6. The controller according to claim 5, wherein said correction signal represents a real-time estimate of the amount of damage being done to the electrical storage device during re-charging.

7. The controller according to claim 5, wherein said damage rate sensor generates said estimated output signal such that a charging current applied to the electrical storage device is applied slowly at the beginning of the charge.

8. The controller according to claim 5, wherein said damage rate sensor generates said estimated output signal such that a charging current is applied more during a first half of a charging period than in a second half of said charging period.

9. The controller according to claim 5, wherein said damage rate sensor generates said estimated output signal such that a charging current applied to the electrical storage device is decreased slowly to zero amperes at the end of a charging period.

10. The controller according to claim 5, wherein said observer component contains model parameters of the electrical storage device which are updated as they change over the life thereof.

11. The controller according to claim 5, further comprising:

a damage rate sensor which receives said input signal, said estimated output signal and aid estimated internal state signal to generate a damage rate signal which estimates the amount of damage being done to the electrical storage device.

12. The controller according to claim 11, further comprising:

a supervisory intelligent controller for receiving said estimated internal state signal, said measure output signal, said damage rate signal and a desired performance input signal, wherein said supervisory intelligent controller generates a charging profile signal.

13. The controller according to claim 12, further comprising:

a battery control system for receiving said measured output signal, said estimated internal state signal and said charging profile signal to generate said input signal, wherein said battery control system adjusts said input signal to optimize charging of the electrical storage device to maximize the life thereof.